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(c) Five observers only judged the central direction either best of all or next best after the resting stimulus.

(d) In four out of these five cases, the number of wrong judgments that involved calling the direction of movement 'central' was either greatest of all, or second only to the number where the stimulus was called 'at rest.'

It looks, then, as if there were a tendency on the part of some of our subjects to make the judgments 'resting' or 'centrally moved' when uncertain, which may account for the apparent superiority of judgments under these two categories.

## IX. A SUGGESTION TOWARDS A STUDY OF THE PERCEPTION OF SOUND MOVEMENT

By JOYCE HICKS and M. F. WASHBURN

The method used in the experiments to be described was as follows. The observer sat with eyes closed. The experimenter stood either behind her, to her right, to her left, or in front of her, and held a König tuning fork, mounted on its sounding box, at a distance of about 50 dm. from the observer's head and on a level with her ears. Chalk marks were made on the floor 30 dm. to the right and left of the point directly over which the fork was held. The fork used was a  $C^3$  of 1,024 vibrations. The fork was struck with a felt hammer by E and moved 30 dm. to the right, left, up, or down. The extent of the movement to the right or left was guided by the marks on the floor; the movements up or down had to have their extent governed merely by E's attempt to make it as nearly as possible equal to that of the others. The duration of the movements was governed by a rhythmic count 'one-two' mentally made by E. An equal number of experiments was made where the movement was in each of the four directions, and also when the fork was held perfectly still and allowed to sound the same length of time as that occupied by a movement. The same number of experiments, in the four directions and with the fork at rest, was made at four different positions, in front of the observer, to her right, to her left, and behind her. Seven persons served as observers, and 164 experiments were made in each of the four positions, making 656 in all.

Tables showing the results are subjoined.

### Position: Front

Direction of Movement	JUDGMENT				Rest
	Up	Down	Right	Left	
Up	39	27	30	31	37
Down	44	23	33	24	38
Right	25	9	101	13	16
Left	36	23	10	79	16
Rest	29	19	22	5	89

Total correct judgments in this position: 331.

### Position: Back

Up	89	30	14	4	27
Down	27	65	22	15	34
Right	21	8	115	8	12
Left	23	11	5	96	18
Rest	28	19	5	10	102

Total correct judgments in this position: 467.

Direction of Movement	Position: Left				Rest
	Up	Down	Right	Left	
Up	<u>68</u>	8	22	38	<u>28</u>
Down	<u>25</u>	<u>49</u>	23	50	<u>15</u>
Right	<u>28</u>	17	<u>60</u>	24	<u>35</u>
Left	<u>32</u>	10	34	<u>44</u>	<u>34</u>
Rest	<u>16</u>	22	14	<u>14</u>	<u>98</u>

Total correct judgments in this position: 319.

	Position: Right				Rest
	Up	Down	Right	Left	
Up	<u>72</u>	14	38	17	<u>23</u>
Down	<u>36</u>	<u>26</u>	45	28	<u>28</u>
Right	<u>41</u>	27	<u>55</u>	21	<u>21</u>
Left	<u>42</u>	20	<u>17</u>	<u>58</u>	<u>27</u>
Rest	<u>23</u>	10	14	<u>12</u>	<u>104</u>

Total correct judgments in this position: 315.

It is unnecessary to point out how rough the method employed in these tests was. There was no accurate control either of the extent of the movement, or of its rate, or of the intensity of the tone. Yet all three of these defects represent variable errors, and in so large a number of experiments they would approach elimination. In any case the study may be useful in suggesting a problem to some one who has more accurate apparatus at his command. A few of its results are sufficiently decided, both in the tables given above and in the figures from the individual observers, to claim some validity. They are as follows:

1. The direction of sound movements is better perceived when the moving tone comes from behind the observer than when it is in any other position. There were 467 correct judgments in this position, whereas 331 was the highest number in any other position. This is interesting because of the tendency noted in experiments on the localization of a resting sound to throw the sound back, a tendency which Gamble explains as due to "serviceable reflex movements in response to noise".

2. When the tone was at rest, the fact was more accurately perceived than was movement in any direction. The total number of correct judgments of the resting tone was 393; the next highest number was 331 for movement to the right. This superiority of the judgments of rest does not seem to be counterbalanced here, as in the experiments on tactile perception of movement, by any tendency, either general or on the part of individuals, to say "no movement" whenever in doubt.

3. Movement downward was on the whole most poorly perceived, the number of correct judgments being 163, and the next higher 268 for movement up.

This may be due to the same cause that renders sounds less easily localizable in the median plane.